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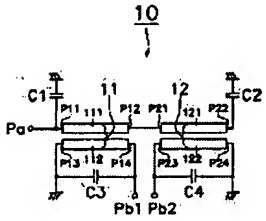
(54) BALANCED-TO-UNBALANCED TRANSFORMER, FREQUENCY CONVERTER AND MOBILE COMMUNICATION EQUIPMENT



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a balanced-to-unbalanced transformer that is small in side and also inexpensive, a frequency converter and mobile communication equipment.

SOLUTION: This balanced-to-unbalanced transformer 10 is provided with 1st coupled lines 11 having a 1st line 111 of 1/4 wavelength where both ends

become 1st and 2nd terminals P11 and P12 and a 2nd line 112 of 1/4 wavelength where both ends become 3rd and 4th terminals P13 and P14, 2nd coupled lines 12 having a 1st line 121 of 1/4 wavelength where both ends become 1st and 2nd terminals P21 and P22 and a 2nd line 122 of 1/4 wavelength where both ends become 3rd and 4th terminals P23 and P24 and capacitors C1 to C4. Then, the terminal P11 of the lines 11 is connected to an unbalanced signal input- output terminal Pa, and the terminal P14 of the lines 11 and the terminal P23 of the lines 12 are connected to balanced signal input-output terminals Pb1 and Pb2.

LEGAL STATUS

[Date of request for examination]

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CLAIMS

[Claim(s)]

[Claim 1] The 1st line where ends serve as the 1st and 2nd terminals, and the 1st tie way which has the 2nd line where ends serve as the 3rd and 4th terminals, It has the 2nd tie way which has the 1st line where ends serve as the 1st and 2nd terminals, and the 2nd line where ends serve as the 3rd and 4th terminals. The 2nd terminal of said 1st tie way and the 1st terminal of said 2nd tie way are connected. The 3rd terminal of said 1st tie way and the 4th terminal of said 2nd tie way are grounded, respectively. The 2nd terminal of said 2nd tie way is opened. The 1st terminal of said 1st tie way An unbalance signal input/output terminal, It is the balanced unbalance converter from which the 4th terminal of said 1st tie way and the 3rd terminal of said 2nd tie way turn into a balanced signal input/output terminal. The balanced unbalance converter characterized by connecting a capacitor to at least one between the 3rd terminal of said 1st tie way, and the 4th terminal, and between the 3rd terminal of said 2nd tie way, and the 4th terminal between the 2nd terminal of said 2nd tie way, and a gland between the 1st terminal of said 1st tie way, and a gland.

[Claim 2] The balanced unbalance converter according to claim 1 characterized by said 1st tie way, the 2nd tie way, and a capacitor consisting of layered products which come to carry out the laminating of two or more dielectric layers.

[Claim 3] It is the frequency converter characterized by being a frequency

converter equipped with the distributor which is 180-degree phase contrast and carries out equipartition of the local oscillation signal, the mixer which changes an input signal according to two output signals from this distributor, and the synthetic vessel which compounds two output signals changed with this mixer, and said distributor consisting of a claim 1 or a balanced unbalance converter according to claim 2.

[Claim 4] It is the mobile communication device characterized by being a mobile communication device equipped with at least the sending circuit which has a frequency converter, or a receiving circuit either [an antenna and], and said frequency converter consisting of frequency converters according to claim 3.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the balanced unbalance converter which allots a RF signal 1GHz or more a compounded part, a frequency converter, and a mobile communication device about a balanced unbalance converter, a frequency converter, and a mobile communication device.

[0002]

[Description of the Prior Art] the RF circuit which generally forms a mobile communication device -- setting -- a RF signal -- amplifier and a mixer -- about 180 degrees -- a phase -- shifting -- about 180 degrees from equipartition or amplifier, or a mixer -- a phase -- shifting -- etc. -- it is necessary to compound Therefore, a RF signal is 180-degree ****** carried out, the balanced unbalance converter which carries out distribution composition is arranged to the input side or output side of amplifier, a mixer, etc., and a RF circuit is constituted.

[0003] Drawing 7 is the block diagram showing the circuitry of the portable telephone which is one of the mobile communication devices. A duplexer 51 distributes the electric wave received through the antenna 52 to a receiving-circuit 54 side while sending out the RF signal from a sending circuit 53 to an antenna 52 side. A sending circuit 53 consists of a low pass filter 551,552, a high power amplifier 56, the double balance mixer 57, balanced unbalance converters 581-583, and a local oscillation circuit 59. The intermediate frequency signal and local oscillation signal with which about 180 degrees of phases differ are needed for the intermediate frequency signal input terminals a and b of the double balance mixer 57, and the local oscillation signal input terminals c and d. In this case, since the local oscillation signal supplied from the intermediate frequency signal through a low pass filter 551 or the local oscillation circuit 59 is an unbalance signal as a single end output, the balanced unbalance transducer 582,583 which achieves the duty of the distributor which is 180-degree phase contrast, carries out equipartition of the unbalance signal, and makes it a balanced signal is connected between the double balance mixer 57 and the local oscillation circuit 59 between the double balance mixer 57 and a low pass filter 552, respectively. Moreover, the RF signal changed by the intermediate frequency signal and the local oscillation signal is outputted to the output terminals e and f of the double balance mixer 57 as a balanced signal, and the low pass filter 551 for removing an unnecessary spurious signal is supplied. Here, since a low pass filter 551 is an unbalanced input, the balanced unbalance

transducer 581 which achieves the duty of the synthetic vessel which compounds the balanced signal outputted from the output terminals e and f of the double balance mixer 57, and is made into an unbalance signal is connected between the double balance mixer 57 and a low pass filter 551.

[0004] Drawing 8 is the representative circuit schematic of the conventional balanced unbalance converter. The balanced unbalance transducer 60 is called MACHANDOBARAN which shifts 180 degrees of phases and allots a signal a compounded part, and is reported by R.Schwindt (1994 IEEE MTT-S International Microwave Symposium Digest, pp.389-391).

[0005] The balanced unbalance converter 60 is equipped with the 1st tie way 61 of the die length of the quarter-wave length which has the 1st terminal 611 - the 4th terminal 614, and the 2nd tie way 62 of the die length of the quarter-wave length which has the 1st terminal 621 - the 4th terminal 624. The 2nd terminal 612 of the 1st tie way 61 and the 1st terminal 621 of the 2nd tie way 62 are connected, the 3rd terminal 613 of the 1st tie way 61 and the 4th terminal 624 of the 2nd tie way 62 are grounded, and the 2nd terminal 622 of the 2nd tie way 62 is opened. And an unbalance signal input/output terminal, the 4th terminal 614 of the 1st tie way 61, and the 3rd terminal 623 of the 2nd tie way 62 turn into [the 1st terminal 611 of the 1st tie way 61] a balanced signal input/output terminal.

[0006] Drawing 9 is the mimetic diagram of a voltage-current wave of the standing wave on the 1/2-wave line in the balanced unbalance converter of drawing 8 . With the 2nd terminal 612 of the 1st tie way 61 in the location of quarter-wave length, and the 1st terminal 621 of the 2nd tie way 62, Current I serves as max and an electrical potential difference V is set to 0. Moreover, an electrical potential difference V serves as an opposite phase with an equal amplitude before and behind the 2nd terminal 612 of the 1st tie way 61, and the 1st terminal 621 of the 2nd tie way 62.

[0007] In addition, there is JP,11-144961,A as an example which constituted the balanced unbalance converter equipped with an equal circuit like drawing 8 from a laminated structure. The surface mount mold balance unbalance converter of

the structure which carried out the laminating of the 1st tie way and the 2nd tie way to the lengthwise direction of the dielectric substrate which consists of crystallized glass etc. is indicated by this.

[0008]

[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional portable telephone, since the low pass filter and the balanced unbalance transducer were constituted as separate discrete part, cost started manufacture and attachment and it had been set to one of the causes which obstruct the miniaturization of a portable telephone. Moreover, transmission loss was generated between the low pass filter and the balanced unbalance converter, and the power consumption of a portable telephone was increased.

[0009] This invention is made in order to solve such a trouble, and it aims at offering a small and cheap balanced unbalance converter, a frequency converter, and a mobile communication device.

[0010]

[Means for Solving the Problem] In order to solve the trouble mentioned above the balanced unbalance converter of this invention The 1st line where ends serve as the 1st and 2nd terminals, and the 1st tie way which has the 2nd line where ends serve as the 3rd and 4th terminals, It has the 2nd tie way which has the 1st line where ends serve as the 1st and 2nd terminals, and the 2nd line where ends serve as the 3rd and 4th terminals. The 2nd terminal of said 1st tie way and the 1st terminal of said 2nd tie way are connected. The 3rd terminal of said 1st tie way and the 4th terminal of said 2nd tie way are grounded, respectively. The 2nd terminal of said 2nd tie way is opened. The 1st terminal of said 1st tie way An unbalance signal input/output terminal, It is the balanced unbalance converter from which the 3rd terminal of the 4th edge of said 1st tie way and said 2nd tie way turns into a balanced signal input/output terminal. It is characterized by connecting a capacitor to at least one between the 3rd terminal of said 1st tie way, and the 4th terminal, and between the 3rd terminal of said 2nd tie way, and the 4th terminal between the 2nd terminal of said 2nd tie way, and a gland

between the 1st terminal of said 1st tie way, and a gland.

[0011] Moreover, the balanced unbalance transducer of this invention is characterized by said 1st tie way, the 2nd tie way, and a capacitor consisting of layered products which come to carry out the laminating of two or more dielectric layers.

[0012] The frequency converter of this invention is a frequency converter equipped with the distributor which is 180-degree phase contrast and carries out equipartition of the local oscillation signal, the mixer which changes an input signal according to two output signals from this distributor, and the synthetic vessel which compounds two output signals changed with this mixer, and said distributor is characterized by consisting of above-mentioned balanced unbalance converters.

[0013] The mobile communication device of this invention is a mobile communication device equipped with either [an antenna and / at least] the sending circuit which has a frequency converter, or a receiving circuit, and said frequency converter is characterized by consisting of above-mentioned frequency converters.

[0014] Between the 1st terminal of the 1st tie way, and a gland, between the 2nd terminal of the 2nd tie way, and a gland, since a capacitor is connected to at least one between the 3rd terminal of the 1st tie way, and the 4th terminal, and between the 3rd terminal of the 2nd tie way, and the 4th terminal, according to the balanced unbalance converter of this invention, the balanced unbalance converter which has low-pass-filter ability can be constituted.

[0015] Since the balanced unbalance converter which has low-pass-filter ability is used according to the frequency converter of this invention, components mark can be lessened.

[0016] According to the mobile communication device of this invention, since the frequency converter in which low-cost-izing, a miniaturization, and high-performance-izing are possible is used, low-cost-izing of a mobile communication device, a miniaturization, and high performance-ization are realizable.

[0017]

[Embodiment of the Invention] Hereafter, the example of this invention is explained with reference to a drawing. Drawing 1 is the representative circuit schematic of one example concerning the balanced unbalance converter of this invention. The 1st tie way 11 where the balanced unbalance converter 10 has the 1st line 111 of the die length of quarter-wave length where ends serve as the 1st and 2nd terminals P11 and P12, and the 2nd line 112 of the die length of quarter-wave length where ends serve as the 3rd and 4th terminals P13 and P14, It has the 2nd tie way 12 which has the 1st line 121 of the die length of quarter-wave length where ends serve as the 1st and 2nd terminals P21 and P22, and the 2nd line 122 of the die length of quarter-wave length where ends serve as the 3rd and 4th terminals P23 and P24, and capacitors C1-C4.

[0018] The 2nd terminal P12 of the 1st tie way 11 and the 1st terminal P21 of the 2nd tie way 12 are connected, the 3rd terminal P13 of the 1st tie way 11 and the 4th terminal P24 of the 2nd tie way 12 are grounded, and the 2nd terminal P22 of the 2nd tie way 12 is opened.

[0019] Moreover, a capacitor C4 is connected between the 1st terminal P11 of the 1st tie way 11, and a gland between the 2nd terminal P22 of a capacitor C1 and the 2nd tie way 12, and a gland, and is connected [between the 3rd terminal P13 of a capacitor C2 and the 1st tie way 11, and the 4th terminal P14], respectively between the 3rd terminal P23 of a capacitor C3 and the 2nd tie way 12, and the 4th terminal P24.

[0020] And the unbalance signal input/output terminal Pa, the 4th terminal P14 of the 1st tie way 11, and the 3rd terminal P23 of the 2nd tie way 12 are connected to the balanced signal input/output terminals Pb1 and Pb2 for the 1st terminal P11 of the 1st tie way 11.

[0021] Drawing 2 is the perspective view of the balanced unbalance converter of drawing 1 . The balanced unbalance converter 10 is equipped with the layered product 13 which built in the transmission line which constitutes the 1st tie way 11 and the 2nd tie way 12 and the grand electrode (not shown), the capacitor

electrode which constitutes capacitors C1-C4, and the grand electrode (not shown). It applies to an underside from the top face of a layered product 13, and the external terminals T1-T6 are formed.

[0022] In addition, as for the external terminals T1 and T6, a balanced signal input/output terminal and the external terminal T2 turn into an unbalance signal input/output terminal, and external terminal T3-T5 turn into a grand terminal.

[0023] Drawing 3 (a) - drawing 3 (h) and drawing 4 (a) - drawing 4 (e) are the plans or bottom views of each dielectric layer which constitute the layered product of the balanced unbalance converter of drawing 2 . A layered product 13 is formed by carrying out the laminating of the 1st - the 12th dielectric layer 13a-13l. which consist of a low-temperature baking ceramic which uses as a principal component the barium oxide which can be calcinated at the temperature of 850 degrees C - 1000 degrees C, an aluminum oxide, and a silica one by one.

[0024] The external terminals T1-T6 are formed in the top face of 1st dielectric layer 13a. Moreover, the grand electrodes Gp1-Gp3 are formed in a dielectric layers [2nd, 7th, and 12th /b / 13 /,g / 13 /, and 13l.] top face, respectively.

[0025] Furthermore, the capacitor electrodes Cp1-Cp4 are formed in the top face of the 3rd, 6th, 8th, and 11th dielectric layers 13c, 13f, 13h, and 13k, respectively. Moreover, the transmission lines Sp1-Sp4 are formed in the top face of the 4th, 5th, 9th, and 10th dielectric layers 13d, 13e, 13i, and 13j, respectively.

[0026] Furthermore, the external terminals T1-T6 are formed in the underside (lu and a sign are attached in drawing 4 (e)) of the 13l. of the 12th dielectric layer. Furthermore, the beer hall electrode Vh is formed in the 3rd - the 8th, 10th, and 11th dielectric layers 13c-13h, and 13j and 13k so that each dielectric layers 13c-13h, and 13j and 13k may be penetrated.

[0027] Under the present circumstances, the 1st and 2nd lines 111,112 (drawing 1) of the 1st tie way 11 are consisted of from the transmission lines Sp1 and Sp2, and the 1st and 2nd lines 121,122 (drawing 1) of the 2nd tie way 12 consist of the transmission lines Sp3 and Sp4, respectively. Moreover, capacitors C1-C4 (drawing 1) consist of the capacitor electrode Cp1, the grand electrode Gp1 and

the capacitor electrode Cp3, the grand electrode Gp2 and the capacitor electrode Cp2, the grand electrode Gp2 and the capacitor electrode Cp4, and a grand electrode Gp3, respectively.

[0028] The balanced unbalance converter 10 equipped with the layered product 13 which builds in the 1st tie way 11 (drawing 1), the 2nd tie way 12 (drawing 1), and capacitors C1-C4 (drawing 1) with the above configurations is formed.

[0029] Drawing 5 is (a) phase characteristic drawing showing basic actuation of the balanced unbalance converter of drawing 1 , and (b) passage property drawing. In drawing 5 , a continuous line shows between the 4th terminal (balanced signal input/output terminal) P14 of the 1st terminal (unbalance signal input/output terminal) P11-1st tie way 11 of the 1st tie way 11, and a broken line shows between the 3rd terminal (balanced signal input/output terminal) P23 of the 1st terminal (unbalance signal input/output terminal) P11-2nd tie way 12 of the 1st tie way 11.

[0030] Drawing 5 (a) shows that 180 degrees of phases are reversed between the 3rd terminal P23 of the 1st terminal P11-2nd tie way 12 of the 1st tie way 11 between the 4th terminal P14 of the 1st terminal P11-1st tie way 11 of the 1st tie way 11 in the balanced unbalance converter 10 of drawing 2 .

[0031] Moreover, pi mold low pass filter which consists of drawing 5 (b) by the 1st line 121 and capacitors C1 and C2 of the 1st line 111 of the 1st tie way 11, and the 2nd tie way 12, With the parallel resonance mold low pass filter constituted from the 2nd line 122 of the 2nd tie way 12, and a capacitor C4 by the parallel resonance mold low pass filter which consists of the 2nd line 112 of the 1st tie way 11, and a capacitor C3, and the list It turns out that secondary 3 order higher-harmonic 2fo of clock frequency fo and 3fo can fully be decreased.

[0032] Between the 1st terminal of the 1st tie way, and a gland, between the 2nd terminal of the 2nd tie way, and a gland, since a capacitor is connected between the 3rd terminal of the 1st tie way, and the 4th terminal, and between the 3rd terminal of the 2nd tie way, and the 4th terminal, according to the balanced unbalance converter of the example mentioned above, the balanced unbalance

converter which has low-pass-filter ability can be constituted. Therefore, the balanced unbalance converter which can attain the balanced unbalance converter which has low-pass-filter ability with easy structure as compared with the conventional example which forms a balanced unbalance converter and a low pass filter as separate components, consequently has low-cost-izing and the low-pass-filter ability which was miniaturized and, in addition, realized reduction of the transmission loss between balanced unbalance converter-low pass filters can be obtained.

[0033] Moreover, since it constitutes from the transmission line which established the 1st and 2nd tie way in the interior of a layered product and constitutes from the capacitor electrode and grand electrode which countered the interior of a layered product mutually and formed the capacitor in it on both sides of the dielectric layer while having the layered product which comes to carry out the laminating of the 1st - the 12th dielectric layer, the components mark of a balanced unbalance converter can be reduced. Therefore, low-cost-izing and a miniaturization are more possible than that of a balanced unbalance converter.

[0034] Drawing 6 is the block diagram of one example concerning the mobile communication device of this invention. The mobile communication device 20 consists of an antenna 21, a duplexer 22, a sending circuit 23, and a receiving circuit 24.

[0035] A duplexer 22 distributes the electric wave received through the antenna 21 to a receiving-circuit 24 side while sending out the RF signal from a sending circuit 23 to an antenna 21 side.

[0036] A sending circuit 23 consists of a high power amplifier PA, a frequency converter CON1, and the modulation section MOD, and a receiving circuit 24 consists of a low noise amplifier LNA, a frequency converter CON2, and the recovery section DEM.

[0037] Under the present circumstances, the frequency converter CON1 of a sending circuit 23 consists of the balanced unbalance transducers BAL11, BAL12, and BAL3, a double balance mixer MIX1, and a local oscillation circuit

LO, and the frequency converter CON2 of a receiving circuit 24 consists of the balanced unbalance transducers BAL21, BAL22, and BAL3, a double balance mixer MIX2, and a local oscillation circuit LO.

[0038] In addition, the balanced unbalance converters BAL11 and BAL22 achieve the duty of the distributor which is 180-degree phase contrast, carries out equipartition of the unbalance signal, and makes it a balanced signal, and the balanced unbalance converters BAL12 and BAL21 achieve the duty of the synthetic vessel which compounds a balanced signal and is made into an unbalance signal.

[0039] In the above configurations, the balanced unbalance converter 10 which has the low-pass-filter ability of drawing 1 is used for the balanced unbalance converters BAL11, BAL21, BAL12, and BAL22 which constitute frequency converters CON1 and CON2.

[0040] In the case of transmission, a local oscillation signal is supplied for an intermediate frequency signal to the intermediate frequency signal input terminals a1 and b1 of the double balance mixer MIX1 in a sending circuit 23 through the balanced unbalance converter BAL 3 at the local oscillation signal input terminals c1 and d1 through the balanced unbalance converter BAL 12, respectively, and the RF signal changed from output terminals e1 and f1 by the intermediate frequency signal and the local oscillation signal is outputted.

[0041] On the other hand, in the case of reception, a local oscillation signal is supplied for a RF signal to the RF signal input terminals a2 and b2 of the double balance mixer MIX2 in a receiving circuit 24 through the balanced unbalance converter BAL 3 at the local oscillation signal input terminals c2 and d2 through the balanced unbalance converter BAL 21, respectively, and the intermediate frequency signal changed from output terminals e2 and f2 by the RF signal and the local oscillation signal is outputted.

[0042] In addition, the unnecessary spurious signal in a RF signal and an intermediate frequency signal is removed by the low-pass-filter ability which the balanced unbalance converters BAL11, BAL12, BAL21, and BAL22 have.

[0043] Since the balanced unbalance converter which has low-pass-filter ability is used according to the frequency converter of the example mentioned above, while being able to lessen components mark, transmission loss can be reduced, consequently low-cost-izing of a frequency converter, miniaturization, and high performance-ization can be realized.

[0044] Moreover, according to the mobile communication device of the example mentioned above, since the frequency converter in which low-cost-izing, a miniaturization, and high-performance-izing are possible is used, low-cost-izing of a mobile communication device, a miniaturization, and high performance-ization are realizable.

[0045] In addition, although the example of an above-mentioned balanced unbalance converter explained the case where a capacitor was connected to all between the 3rd terminal of the 1st tie way, and the 4th terminal, and between the 3rd terminal of the 2nd tie way, and the 4th terminal between the 2nd terminal of the 2nd tie way, and a gland between the 1st terminal of the 1st tie way, and a gland If a capacitor is connected to at least one place, it will have the function of a low pass filter and the same effectiveness will be acquired.

[0046] Moreover, although the dielectric layer explained the case of the ceramics which uses the barium oxide, an aluminum oxide, and a silica as a principal component, effectiveness with the same said also of the ceramics or fluororesin which which ingredient is sufficient as with [specific inductive capacity (epsilonr)] one [or more], for example, uses a magnesium oxide and a silica as a principal component is acquired.

[0047] Furthermore, although the above-mentioned mobile communication device explained the case where a balanced unbalance converter and a local oscillation circuit were carried out in common with the frequency converter of a sending circuit, and the frequency converter of a receiving circuit, it may be prepared independently.

[0048]

[Effect of the Invention] According to the balanced unbalance converter of claim 1,

between the 1st terminal of the 1st tie way, and a gland, In order to connect a capacitor to at least one between the 3rd terminal of the 1st tie way, and the 4th terminal, and between the 3rd terminal of the 2nd tie way, and the 4th terminal between the 2nd terminal of the 2nd tie way, and a gland, It compares with the conventional example which forms a balanced unbalance converter and a low pass filter as separate components. The balanced unbalance converter which can attain the balanced unbalance converter which has low-pass-filter ability with easy structure, consequently has low-cost-izing and the low-pass-filter ability which was miniaturized and, in addition, realized reduction of the transmission loss between balanced unbalance converter-low pass filters can be obtained.

[0049] Since the 1st tie way, the 2nd tie way, and a capacitor consist of layered products which come to carry out the laminating of two or more dielectric layers according to the balanced unbalance transducer of claim 2, the components mark of a balanced unbalance transducer can be reduced. Therefore, low-cost-izing and a miniaturization are more possible than that of a balanced unbalance converter.

[0050] Since the balanced unbalance converter which has low-pass-filter ability is used according to the frequency converter of claim 3, while being able to lessen components mark, transmission loss can be reduced, consequently low-cost-izing of a frequency converter, miniaturization, and high performance-ization can be realized.

[0051] According to the mobile communication device of claim 4, since the frequency converter in which low-cost-izing, a miniaturization, and high-performance-izing are possible is used, low-cost-izing of a mobile communication device, a miniaturization, and high performance-ization are realizable.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the representative circuit schematic of one example concerning the balanced unbalance converter of this invention.

[Drawing 2] It is the perspective view showing an example unbalance converter [of drawing 1 / balanced] configuration.

[Drawing 3] It is the plan of the (a) 1st dielectric layer - (h) 8th dielectric layer which constitutes the layered product of the balanced unbalance converter of drawing 2 .

[Drawing 4] They are the plan of the (a) 9th dielectric layer - (d) 12th dielectric layer which constitutes the layered product of the balanced unbalance converter of drawing 2 , and the bottom view of the (e) 12th dielectric layer.

[Drawing 5] They are (a) phase characteristic drawing showing basic actuation of the balanced unbalance converter of drawing 1 , and (b) passage property drawing.

[Drawing 6] It is the block diagram of one example concerning the mobile communication device of this invention.

[Drawing 7] It is the block diagram showing the circuitry of a common portable telephone.

[Drawing 8] It is the representative circuit schematic of the conventional balanced unbalance converter.

[Drawing 9] It is the mimetic diagram of a voltage-current wave of the standing

wave on the 1/2-wave line in a ****** unbalance converter.

[Description of Notations]

10 Balanced Unbalance Converter

11 1st Tie Way

12 2nd Tie Way

111,121 The 1st line

112,122 The 2nd line

13 Layered Product

13a-13l. Dielectric layer

20 Mobile Communication Device

21 Antenna

23 Sending Circuit

24 Receiving Circuit

C1-C4 Capacitor

CON1, CON2 Frequency converter

DEM Recovery section

MOD Modulation section

P11-P14, P21-P24 The 1st - the 4th terminal

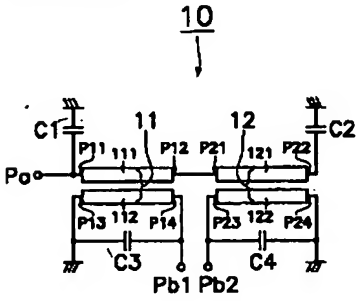
Pa Balanced signal input/output terminal

Pb1, Pb2 Unbalance signal input/output terminal

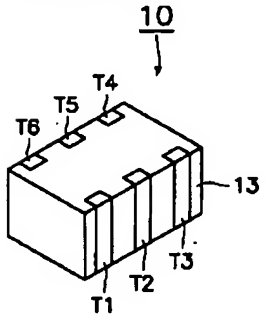
[Translation done.]

DRAWINGS

[Drawing 1]



[Drawing 2]



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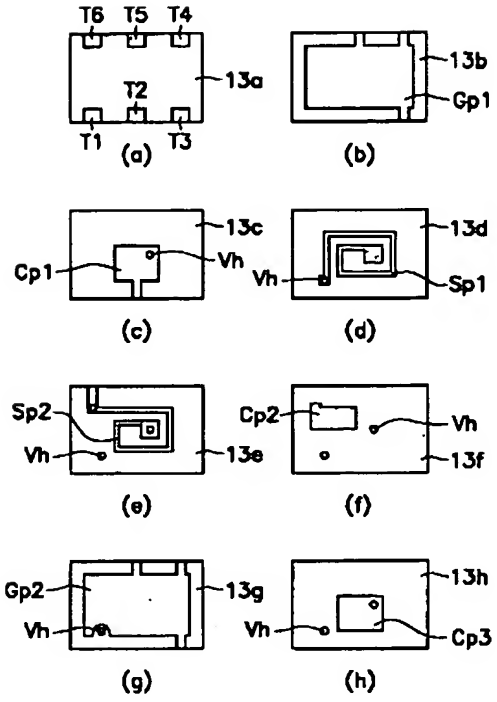

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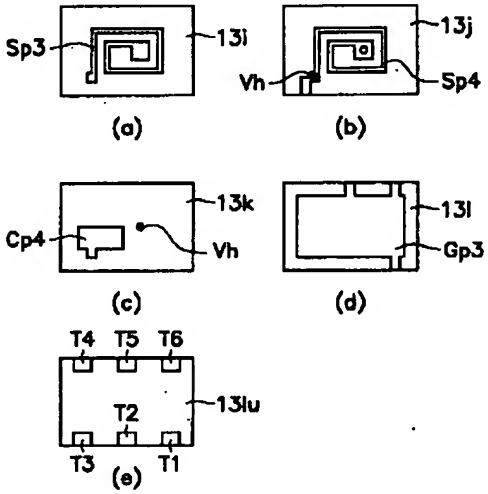

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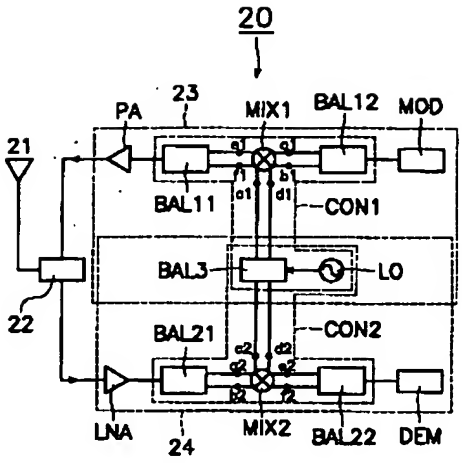
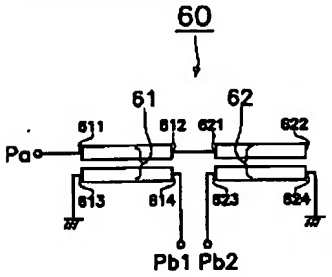
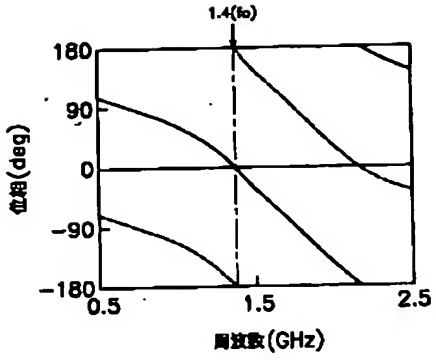


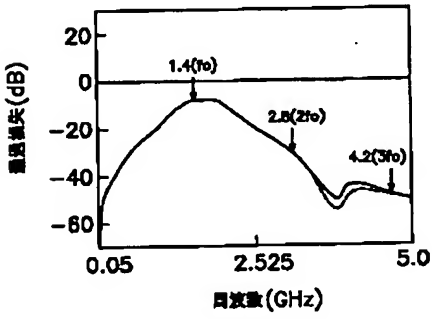
[Drawing 8]



[Drawing 5]

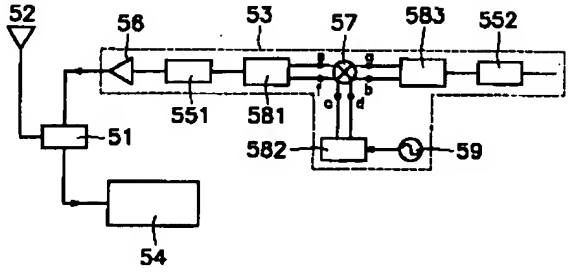


(a)

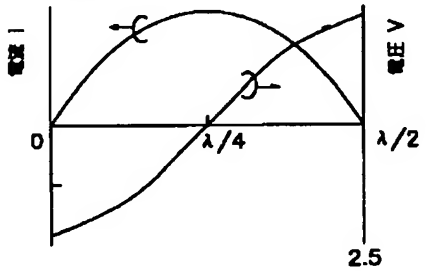


(b)

[Drawing 7]



[Drawing 9]



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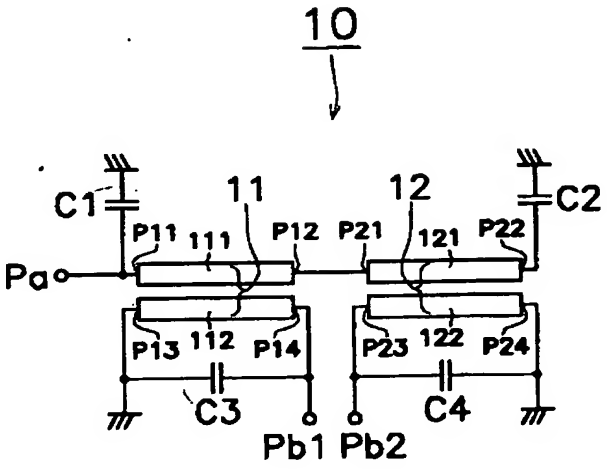
最終頁に続く

(54)【発明の名称】平衡不平衡変換器、周波数変換器、及び移動体通信装置

(57)【要約】

【課題】　小型でかつ安価な平衡不平衡変換器、周波数変換器、及び移動体通信装置を提供する。

【解決手段】　平衡不平衡変換器１０は、両端が第１及び第２端子Ｐ１１，Ｐ１２となる１／４波長の長さの第１線路１１１、及び両端が第３及び第４端子Ｐ１３，Ｐ１４となる１／４波長の長さの第２線路１１２を有する第１結合線路１１と、両端が第１及び第２端子Ｐ２１，Ｐ２２となる１／４波長の長さの第１線路１２１、及び両端が第３及び第４端子Ｐ２３，Ｐ２４となる１／４波長の長さの第２線路１２２を有する第２結合線路１２と、コンデンサＣ１～Ｃ４とを備える。そして、第１結合線路１１の第１端子Ｐ１１が不平衡信号入出力端子Ｐａ、第１結合線路１１の第４端子Ｐ１４及び第２結合線路１２の第３端子Ｐ２３が平衡信号入出力端子Ｐｂ１，Ｐｂ２に接続される。



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【特許請求の範囲】

【請求項１】　両端が第１及び第２端子となる第１線路、及び両端が第３及び第４端子となる第２線路を有する第１結合線路と、両端が第１及び第２端子となる第１線路、及び両端が第３及び第４端子となる第２線路を有する第２結合線路とを備え、前記第１結合線路の第２端子と前記第２結合線路の第１端子とが接続され、前記第１結合線路の第３端子と前記第２結合線路の第４端子とがそれぞれ接地され、前記第２結合線路の第２端子が開放され、前記第１結合線路の第１端子が不平衡信号入出力端子、前記第１結合線路の第４端子及び前記第２結合線路の第３端子が平衡信号入出力端子となる平衡不平衡変換器であって、

前記第１結合線路の第１端子、グランド間、前記第２結合線路の第２端子、グランド間、前記第１結合線路の第３端子、第４端子間、及び前記第２結合線路の第３端子、第４端子間の少なくとも１つにコンデンサを接続したことを特徴とする平衡不平衡変換器。

【請求項２】　前記第１結合線路、第２結合線路及びコンデンサが、複数の誘電体層を積層してなる積層体で構成されることを特徴とする請求項１に記載の平衡不平衡変換器。

【請求項３】　局部発振信号を１８０°の位相差で等分配する分配器と、該分配器からの２つの出力信号に応じて入力信号を変換するミキサと、該ミキサで変換された２つの出力信号を合成する合成器とを備える周波数変換器であって、前記分配器は、請求項１あるいは請求項２に記載の平衡不平衡変換器で構成されることを特徴とする周波数変換器。

【請求項４】　アンテナと、周波数変換器を有する送信回路及び受信回路の少なくとも一方とを備える移動体通信装置であって、

前記周波数変換器は、請求項３に記載の周波数変換器で構成されることを特徴とする移動体通信装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、平衡不平衡変換器、周波数変換器、及び移動体通信装置に関し、特に、１ＧＨｚ以上の高周波信号を合成分配する平衡不平衡変換器、周波数変換器、及び移動体通信装置に関する。

【０００２】

【従来の技術】一般に、移動体通信装置を形成する高周波回路において、高周波信号を増幅器やミキサに１８０°位相をずらして等分配、または増幅器やミキサから１８０°位相をずらして等合成する必要がある。そのために、高周波信号を１８０°位相ずらして分配合成する平衡不平衡変換器を増幅器やミキサなどの入力側または出力側に配置し、高周波回路を構成する。

【０００３】図７は、移動体通信装置の１つである携帯電話機の回路構成を示すブロック図である。デュプレクサ５１は、送信回路５３からの高周波信号をアンテナ５２側へ送出するとともに、アンテナ５２を介して受信した電波を受信回路５４側へ振り分ける。送信回路５３は、低域通過フィルタ５５１，５５２、高出力増幅器５６、ダブルバランスミキサ５７、平衡不平衡変換器５８１～５８３及び局部発振回路５９からなる。ダブルバランスミキサ５７の中間周波信号入力端子ａ，ｂ、局部発振信号入力端子ｃ，ｄには、１８０°位相の異なる中間周波信号や局部発振信号が必要とされる。この場合、低域通過フィルタ５５１を介した中間周波信号や局部発振回路５９から供給される局部発振信号はシングルエンド出力としての不平衡信号であるため、不平衡信号を１８０°の位相差で等分配して平衡信号とする分配器の役目を果す平衡不平衡変換器５８２，５８３が、ダブルバランスミキサ５７と低域通過フィルタ５５２との間、ダブルバランスミキサ５７と局部発振回路５９との間にそれぞれ接続される。また、ダブルバランスミキサ５７の出力端子ｅ，ｆには中間周波信号と局部発振信号とにより変換された高周波信号が平衡信号として出力され、不要なスプリアス信号を除去するための低域通過フィルタ５５１に供給される。ここで、低域通過フィルタ５５１は不平衡入力であるため、ダブルバランスミキサ５７の出力端子ｅ，ｆから出力される平衡信号を合成して不平衡信号とする合成器の役目を果す平衡不平衡変換器５８１が、ダブルバランスミキサ５７と低域通過フィルタ５５１との間に接続される。

【０００４】図８は、従来の平衡不平衡変換器の等価回路図である。平衡不平衡変換器６０は、位相を１８０°ずらして信号を合成分配するマーチャンドバランと呼ばれるもので、R. Schwindtにより報告されている（1994 IEEE MTT-S International Microwave Symposium Digest, pp. 389-391）。

【０００５】平衡不平衡変換器６０は、第１端子６１１～第４端子６１４を有する１／４波長の長さの第１結合線路６１と、第１端子６２１～第４端子６２４を有する１／４波長の長さの第２結合線路６２とを備える。第１結合線路６１の第２端子６１２と第２結合線路６２の第１端子６２１とが接続され、第１結合線路６１の第３端子６１３、及び第２結合線路６２の第４端子６２４が接地され、第２結合線路６２の第２端子６２２が開放される。そして、第１結合線路６１の第１端子６１１が不平衡信号入出力端子、第１結合線路６１の第４端子６１４及び第２結合線路６２の第３端子６２３が平衡信号入出力端子となる。

【０００６】図９は、図８の平衡不平衡変換器における１／２波長線路上の定在波の電圧・電流波形の模式図である。１／４波長の位置にある第１結合線路６１の第２端子６１２及び第２結合線路６２の第１端子６２１で、電流Ｉは最大となり、電圧Ｖは０となる。また、電圧Ｖは第１結合線路６１の第２端子６１２及び第２結合線路

６２の第１端子６２１の前後では等振幅で逆位相となる。

【０００７】なお、図８のような等価回路を備えた平衡不平衡変換器を積層構造で構成した例として、特開平１１－１４４９６１号公報がある。これには、第１結合線路と第２の結合線路をガラスセラミックス等からなる誘電体基板の縦方向に積層した構造の表面実装型平衡不平衡変換器が開示されている。

【０００８】

【発明が解決しようとする課題】ところが、上記従来の携帯電話機においては、低域通過フィルタと平衡不平衡変換器とを別々のディスクリート部品として構成しているため、製造及び組み付けにコストがかかり、携帯電話機の小型化を阻む原因の１つとなっていた。また、低域通過フィルタと平衡不平衡変換器との間で伝送損失を発生させ、携帯電話機の消費電力を増大させていた。

【０００９】本発明は、このような問題点を解決するためになされたものであり、小型でかつ安価な平衡不平衡変換器、周波数変換器、及び移動体通信装置を提供することを目的とする。

【００１０】

【課題を解決するための手段】上述する問題点を解決するため本発明の平衡不平衡変換器は、両端が第１及び第２端子となる第１線路、及び両端が第３及び第４端子となる第２線路を有する第１結合線路と、両端が第１及び第２端子となる第１線路、及び両端が第３及び第４端子となる第２線路を有する第２結合線路とを備え、前記第１結合線路の第２端子と前記第２結合線路の第１端子とが接続され、前記第１結合線路の第３端子と前記第２結合線路の第４端子とがそれぞれ接地され、前記第２結合線路の第２端子が開放され、前記第１結合線路の第１端子が不平衡信号入出力端子、前記第１結合線路の第４端及び前記第２結合線路の第３端子が平衡信号入出力端子となる平衡不平衡変換器であって、前記第１結合線路の第１端子、グランド間、前記第２結合線路の第２端子、グランド間、前記第１結合線路の第３端子、第４端子間、及び前記第２結合線路の第３端子、第４端子間の少なくとも１つにコンデンサを接続したことを特徴とする。

【００１１】また、本発明の平衡不平衡変換器は、前記第１結合線路、第２結合線路及びコンデンサが、複数の誘電体層を積層してなる積層体で構成されることを特徴とする。

【００１２】本発明の周波数変換器は、局部発振信号を１８０°の位相差で等分配する分配器と、該分配器からの２つの出力信号に応じて入力信号を変換するミキサと、該ミキサで変換された２つの出力信号を合成する合成器とを備える周波数変換器であって、前記分配器は、上述の平衡不平衡変換器で構成されることを特徴とする。

【００１３】本発明の移動体通信装置は、アンテナと、周波数変換器を有する送信回路及び受信回路の少なくとも一方とを備える移動体通信装置であって、前記周波数変換器は、上述の周波数変換器で構成されることを特徴とする。

【００１４】本発明の平衡不平衡変換器によれば、第１結合線路の第１端子、グランド間、第２結合線路の第２端子、グランド間、第１結合線路の第３端子、第４端子間、及び第２結合線路の第３端子、第４端子間の少なくとも１つにコンデンサを接続するため、低域通過フィルタ機能を有する平衡不平衡変換器を構成することができる。

【００１５】本発明の周波数変換器によれば、低域通過フィルタ機能を有する平衡不平衡変換器を用いているため、部品点数を少なくすることができる。

【００１６】本発明の移動体通信装置によれば、低コスト化、小型化及び高性能化が可能な周波数変換器を用いているため、移動体通信装置の低コスト化、小型化及び高性能化を実現することができる。

【００１７】

【発明の実施の形態】以下、図面を参照して本発明の実施例を説明する。図１は、本発明の平衡不平衡変換器に係る一実施例の等価回路図である。平衡不平衡変換器１０は、両端が第１及び第２端子Ｐ１１，Ｐ１２となる１／４波長の長さの第１線路１１１、及び両端が第３及び第４端子Ｐ１３，Ｐ１４となる１／４波長の長さの第２線路１１２を有する第１結合線路１１と、両端が第１及び第２端子Ｐ２１，Ｐ２２となる１／４波長の長さの第１線路１２１、及び両端が第３及び第４端子Ｐ２３，Ｐ２４となる１／４波長の長さの第２線路１２２を有する第２結合線路１２と、コンデンサＣ１～Ｃ４とを備える。

【００１８】第１結合線路１１の第２端子Ｐ１２と第２結合線路１２の第１端子Ｐ２１とが接続され、第１結合線路１１の第３端子Ｐ１３、及び第２結合線路１２の第４端子Ｐ２４が接地され、第２結合線路１２の第２端子Ｐ２２が開放される。

【００１９】また、第１結合線路１１の第１端子Ｐ１１、グランド間にコンデンサＣ１、第２結合線路１２の第２端子Ｐ２２、グランド間にコンデンサＣ２、第１結合線路１１の第３端子Ｐ１３、第４端子Ｐ１４間にコンデンサＣ３、第２結合線路１２の第３端子Ｐ２３、第４端子Ｐ２４間にコンデンサＣ４がそれぞれ接続される。

【００２０】そして、第１結合線路１１の第１端子Ｐ１１が不平衡信号入出力端子Ｐａ、第１結合線路１１の第４端子Ｐ１４及び第２結合線路１２の第３端子Ｐ２３が平衡信号入出力端子Ｐｂ１，Ｐｂ２に接続される。

【００２１】図２は、図１の平衡不平衡変換器の斜視図である。平衡不平衡変換器１０は、第１結合線路１１及び第２結合線路１２を構成する伝送線路及びグランド電

極（図示せず）、コンデンサＣ１～Ｃ４を構成するコンデンサ電極及びグランド電極（図示せず）を内蔵した積層体１３を備える。積層体１３の上面から下面にかけて外部端子Ｔ１～Ｔ６が設けられる。

【００２２】なお、外部端子Ｔ１，Ｔ６は平衡信号入出力端子、外部端子Ｔ２は不平衡信号入出力端子、外部端子Ｔ３～Ｔ５はグランド端子となる。

【００２３】図３（ａ）～図３（ｈ）及び図４（ａ）～図４（ｅ）は、図２の平衡不平衡変換器の積層体を構成する各誘電体層の上面図あるいは下面図である。積層体１３は、例えば８５０℃～１０００℃の温度で焼成可能な酸化バリウム、酸化アルミニウム、シリカを主成分とする低温焼成セラミックからなる第１～第１２の誘電体層１３ａ～１３ｌを順次積層することによって形成される。

【００２４】第１の誘電体層１３ａの上面には外部端子Ｔ１～Ｔ６が形成される。また、第２、第７及び第１２の誘電体層１３ｂ，１３ｇ，１３ｌの上面にはグランド電極Ｇｐ１～Ｇｐ３がそれぞれ形成される。

【００２５】さらに、第３、第６、第８及び第１１の誘電体層１３ｃ，１３ｆ，１３ｈ，１３ｋの上面にはコンデンサ電極Ｃｐ１～Ｃｐ４がそれぞれ形成される。また、第４、第５、第９及び第１０の誘電体層１３ｄ，１３ｅ，１３ｉ，１３ｊの上面には伝送線路Ｓｐ１～Ｓｐ４がそれぞれ形成される。

【００２６】さらに、第１２の誘電体層１３ｌの下面（図４（ｅ）中において、ｌｕと符号を付す）には外部端子Ｔ１～Ｔ６が形成される。さらに、第３～第８、第１０及び第１１の誘電体層１３ｃ～１３ｈ，１３ｊ，１３ｋには各誘電体層１３ｃ～１３ｈ，１３ｊ，１３ｋを貫通するようにビアホール電極Ｖｈが形成される。

【００２７】この際、伝送線路Ｓｐ１，Ｓｐ２で第１結合線路１１の第１及び第２線路１１１，１１２（図１）を、伝送線路Ｓｐ３，Ｓｐ４で第２結合線路１２の第１及び第２線路１２１，１２２（図１）をそれぞれ構成する。また、コンデンサ電極Ｃｐ１とグランド電極Ｇｐ１、コンデンサ電極Ｃｐ３とグランド電極Ｇｐ２、コンデンサ電極Ｃｐ２とグランド電極Ｇｐ２、コンデンサ電極Ｃｐ４とグランド電極Ｇｐ３とでコンデンサＣ１～Ｃ４（図１）をそれぞれ構成する。

【００２８】以上のような構成で、第１結合線路１１（図１）、第２結合線路１２（図１）、コンデンサＣ１～Ｃ４（図１）を内蔵する積層体１３を備えた平衡不平衡変換器１０が形成される。

【００２９】図５は、図１の平衡不平衡変換器の基本動作を示す（ａ）位相特性図、（ｂ）通過特性図である。図５において、実線は第１結合線路１１の第１端子（不平衡信号入出力端子）Ｐ１１－第１結合線路１１の第４端子（平衡信号入出力端子）Ｐ１４間、破線は第１結合線路１１の第１端子（不平衡信号入出力端子）Ｐ１１－第２結合線路１２の第３端子（平衡信号入出力端子）Ｐ２３間を示す。

【００３０】図５（ａ）から、図２の平衡不平衡変換器１０において、第１結合線路１１の第１端子Ｐ１１－第１結合線路１１の第４端子Ｐ１４間と第１結合線路１１の第１端子Ｐ１１－第２結合線路１２の第３端子Ｐ２３間とで位相が１８０°反転していることが解る。

【００３１】また、図５（ｂ）から、第１結合線路１１の第１線路１１１、第２結合線路１２の第１線路１２１及びコンデンサＣ１，Ｃ２で構成されるπ型低域通過フィルタ、第１結合線路１１の第２線路１１２、コンデンサＣ３で構成される並列共振型低域通過フィルタ、並びに、第２結合線路１２の第２線路１２２、コンデンサＣ４で構成される並列共振型低域通過フィルタにより、動作周波数ｆｏの２次及び３次高調波２ｆｏ，３ｆｏを十分に減衰できていることが解る。

【００３２】上述した実施例の平衡不平衡変換器によれば、第１結合線路の第１端子、グランド間、第２結合線路の第２端子、グランド間、第１結合線路の第３端子、第４端子間、及び第２結合線路の第３端子、第４端子間にコンデンサを接続するため、低域通過フィルタ機能を有する平衡不平衡変換器を構成することができる。したがって、平衡不平衡変換器と低域通過フィルタとを別々の部品として形成する従来例と比較して、低域通過フィルタ機能を有する平衡不平衡変換器を簡単な構造で達成でき、その結果、低コスト化、小型化、加えて平衡不平衡変換器－低域通過フィルタ間の伝送損失の低減を実現した低域通過フィルタ機能を有する平衡不平衡変換器を得ることができる。

【００３３】また、第１～第１２の誘電体層を積層してなる積層体を備えるとともに、第１及び第２結合線路を積層体の内部に設けた伝送線路で構成し、コンデンサを積層体の内部に誘電体層を挟んで互いに対向して設けたコンデンサ電極及びグランド電極で構成するため、平衡不平衡変換器の部品点数を低減することができる。したがって、平衡不平衡変換器のより低コスト化、小型化が可能である。

【００３４】図６は、本発明の移動体通信装置に係る一実施例のブロック図である。移動体通信装置２０は、アンテナ２１、デュプレクサ２２、送信回路２３及び受信回路２４で構成される。

【００３５】デュプレクサ２２は、送信回路２３からの高周波信号をアンテナ２１側へ送出するとともに、アンテナ２１を介して受信した電波を受信回路２４側へ振り分ける。

【００３６】送信回路２３は、高出力増幅器ＰＡ、周波数変換器ＣＯＮ１及び変調部ＭＯＤで構成され、受信回路２４は、低雑音増幅器ＬＮＡ、周波数変換器ＣＯＮ２及び復調部ＤＥＭで構成される。

【００３７】この際、送信回路２３の周波数変換器ＣＯ

Ｎ１は、平衡不平衡変換器ＢＡＬ１１，ＢＡＬ１２，ＢＡＬ３、ダブルバランスミキサＭＩＸ１、局部発振回路ＬＯからなり、受信回路２４の周波数変換器ＣＯＮ２は、平衡不平衡変換器ＢＡＬ２１，ＢＡＬ２２，ＢＡＬ３、ダブルバランスミキサＭＩＸ２、局部発振回路ＬＯからなる。

【００３８】なお、平衡不平衡変換器ＢＡＬ１１，ＢＡＬ２２は、不平衡信号を１８０°の位相差で等分配して平衡信号とする分配器の役目を果し、平衡不平衡変換器ＢＡＬ１２，ＢＡＬ２１は、平衡信号を合成して不平衡信号とする合成器の役目を果す。

【００３９】以上のような構成において、周波数変換器ＣＯＮ１，ＣＯＮ２を構成する平衡不平衡変換器ＢＡＬ１１，ＢＡＬ２１，ＢＡＬ１２，ＢＡＬ２２に、図１の低域通過フィルタ機能を有する平衡不平衡変換器１０を用いるものである。

【００４０】送信の際には、送信回路２３におけるダブルバランスミキサＭＩＸ１の中間周波信号入力端子ａ１，ｂ１に平衡不平衡変換器ＢＡＬ１２を介して中間周波信号が、局部発振信号入力端子ｃ１，ｄ１に平衡不平衡変換器ＢＡＬ３を介して局部発振信号がそれぞれ供給され、出力端子ｅ１，ｆ１から中間周波信号と局部発振信号とにより変換された高周波信号が出力される。

【００４１】一方、受信の際には、受信回路２４におけるダブルバランスミキサＭＩＸ２の高周波信号入力端子ａ２，ｂ２に平衡不平衡変換器ＢＡＬ２１を介して高周波信号が、局部発振信号入力端子ｃ２，ｄ２に平衡不平衡変換器ＢＡＬ３を介して局部発振信号がそれぞれ供給され、出力端子ｅ２，ｆ２から高周波信号と局部発振信号とにより変換された中間周波信号が出力される。

【００４２】なお、高周波信号及び中間周波信号における不要なスプリアス信号は平衡不平衡変換器ＢＡＬ１１，ＢＡＬ１２，ＢＡＬ２１，ＢＡＬ２２が有する低域通過フィルタ機能により除去される。

【００４３】上述した実施例の周波数変換器によれば、低域通過フィルタ機能を有する平衡不平衡変換器を用いているため、部品点数を少なくすることができるとともに、伝送損失を低減でき、その結果、周波数変換器の低コスト化、小型化及び高性能化を実現することができる。

【００４４】また、上述した実施例の移動体通信装置によれば、低コスト化、小型化及び高性能化が可能な周波数変換器を用いているため、移動体通信装置の低コスト化、小型化及び高性能化を実現することができる。

【００４５】なお、上述の平衡不平衡変換器の実施例では、第１結合線路の第１端子、グランド間、第２結合線路の第２端子、グランド間、第１結合線路の第３端子、第４端子間、及び第２結合線路の第３端子、第４端子間の全てにコンデンサを接続した場合について説明したが、少なくとも１ヶ所にコンデンサを接続すれば低域通過フィルタの機能を有することとなり同様の効果が得られる。

【００４６】また、誘電体層が、酸化バリウム、酸化アルミニウム、シリカを主成分とするセラミックスの場合について説明したが、比誘電率（εｒ）が１以上であれば何れの材料でもよく、例えば酸化マグネシウム、シリカを主成分とするセラミックスあるいはフッ素系樹脂等でも同様の効果が得られる。

【００４７】さらに、上述の移動体通信装置では、送信回路の周波数変換器と受信回路の周波数変換器とで平衡不平衡変換器及び局部発振回路を共通にした場合について説明したが、別々に設けられていてもよい。

【００４８】

【発明の効果】請求項１の平衡不平衡変換器によれば、第１結合線路の第１端子、グランド間、第２結合線路の第２端子、グランド間、第１結合線路の第３端子、第４端子間、及び第２結合線路の第３端子、第４端子間の少なくとも１つにコンデンサを接続するため、平衡不平衡変換器と低域通過フィルタとを別々の部品として形成する従来例と比較して、低域通過フィルタ機能を有する平衡不平衡変換器を簡単な構造で達成でき、その結果、低コスト化、小型化、加えて平衡不平衡変換器－低域通過フィルタ間の伝送損失の低減を実現した低域通過フィルタ機能を有する平衡不平衡変換器を得ることができる。

【００４９】請求項２の平衡不平衡変換器によれば、第１結合線路、第２結合線路及びコンデンサが、複数の誘電体層を積層してなる積層体で構成されるため、平衡不平衡変換器の部品点数を低減することができる。したがって、平衡不平衡変換器のより低コスト化、小型化が可能である。

【００５０】請求項３の周波数変換器によれば、低域通過フィルタ機能を有する平衡不平衡変換器を用いているため、部品点数を少なくすることができるとともに、伝送損失の低減でき、その結果、周波数変換器の低コスト化、小型化及び高性能化を実現することができる。

【００５１】請求項４の移動体通信装置によれば、低コスト化、小型化及び高性能化が可能な周波数変換器を用いているため、移動体通信装置の低コスト化、小型化及び高性能化を実現することができる。

【図面の簡単な説明】

【図１】本発明の平衡不平衡変換器に係る一実施例の等価回路図である。

【図２】図１の平衡不平衡変換器の具体例な構成を示す斜視図である。

【図３】図２の平衡不平衡変換器の積層体を構成する（ａ）第１の誘電体層～（ｈ）第８の誘電体層の上面図である。

【図４】図２の平衡不平衡変換器の積層体を構成する（ａ）第９の誘電体層～（ｄ）第１２の誘電体層の上面図及び（ｅ）第１２の誘電体層の下面図である。

【図５】図１の平衡不平衡変換器の基本動作を示す（ａ）位相特性図、（ｂ）通過特性図である。

【図６】本発明の移動体通信装置に係る一実施例のブロック図である。

【図７】一般的な携帯電話機の回路構成を示すブロック図である。

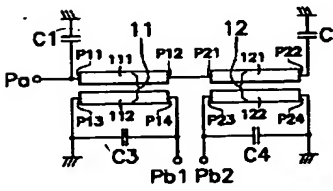
【図８】従来の平衡不平衡変換器の等価回路図である。

【図９】の平衡不平衡変換器における１／２波長線路上の定在波の電圧・電流波形の模式図である。

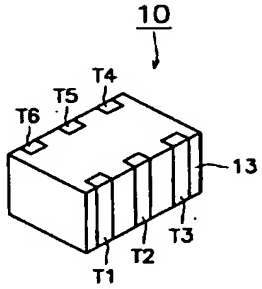
【符号の説明】

１０　　平衡不平衡変換器
１１　　第１結合線路
１２　　第２結合線路
１１１，１２１　　第１線路
１１２，１２２　　第２線路
１３　　積層体
１３ａ～１３ｌ　　誘電体層
２０　　移動体通信装置
２１　　アンテナ
２３　　送信回路
２４　　受信回路
Ｃ１～Ｃ４　　コンデンサ
ＣＯＮ１，ＣＯＮ２　　周波数変換器
ＤＥＭ　　復調部
ＭＯＤ　　変調部
Ｐ１１～Ｐ１４，Ｐ２１～Ｐ２４　　第１～第４端子
Ｐａ　　平衡信号入出力端子
Ｐｂ１，Ｐｂ２　　不平衡信号入出力端子

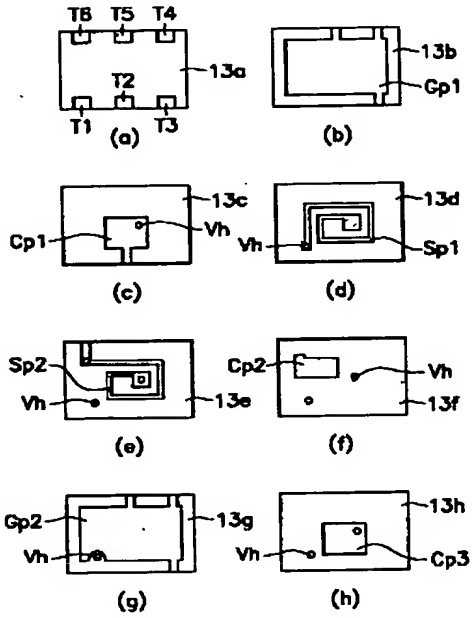
【図１】



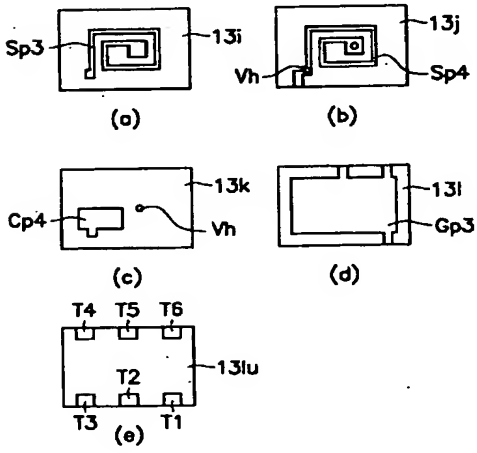
【図２】



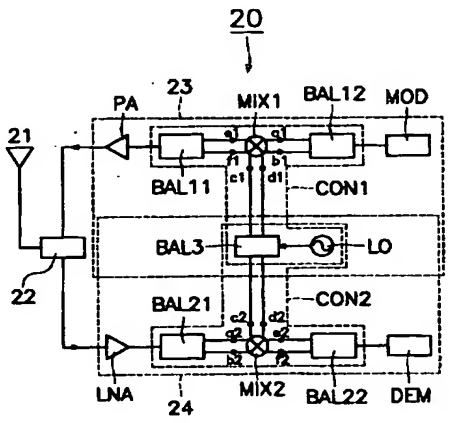
【図３】



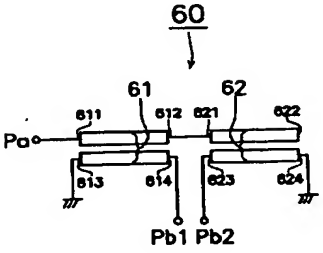
【図４】



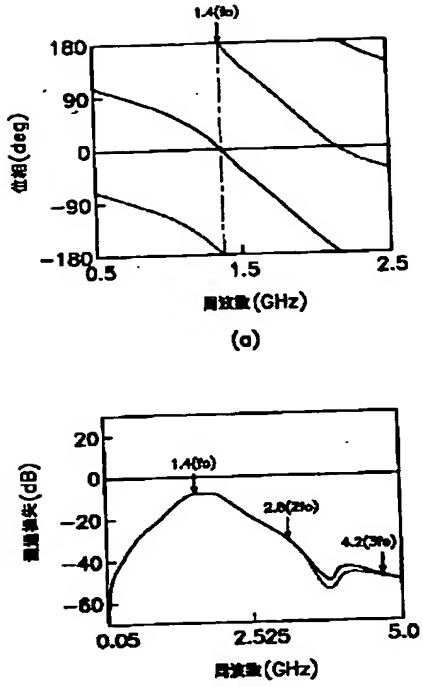
【図６】



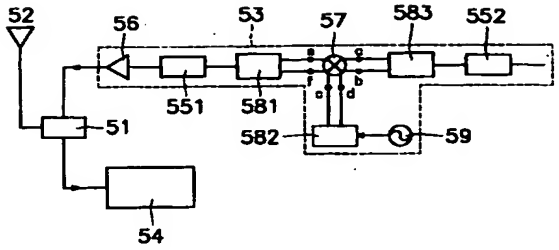
【図８】



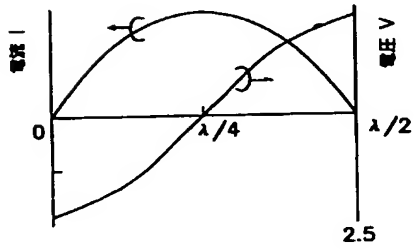
【図５】



【図７】



【図９】



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